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ABSTRACT

To provide a further test of the paired-associate analogy to retroactive inhibition in free recall, this experiment investigated the effect of presenting both original learning (OL) and interpolated learning (IL) in either blocked category (B) or random (R) fashion. IL-OL Similar (S), IL-OL Different (D), and control (C) conditions were included. A total of 60 male and 60 female university students were equally and randomly assigned to each of the six cells of the 2 x 3 factorial design. The lists contained 20 words, five from each of four categories. The experimental session consisted of (1) acquisition of OL list, (2) acquisition of IL list, and (3) criterion recall of OL list. Among the findings were the following: (1) For OL learning, the R groups took more trials to reach criterion than the B groups, and no main effect was found for the OL-IL similarity factor. (2) For IL learning, the presentation factor was again significant, favoring the B groups; there was also a main effect for IL learning due to OL-IL similarity, with the D groups recalling more words than the S groups, and (3) The presentation factor was not a significant source of variance for criterion recall of OL words; however, the main effect due to OL-IL similarity was significant. The number of words recalled decreased in the order of C, D, and S groups. References are included. (AW)

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A Test of the Paired-Associate Analogy to RI in Free Recall[1]

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Several studies in recent years (Shuell, 1968; Thompson and Poling, 1969; Watts and Anderson, 1969; Winograd, 1968) have examined RI in free recall (FR) by manipulating the organizational similarity of successively learned lists. The studies cited above presented Ss with successive lists containing words from the same (S) categories or words from different (D) categories; with the result being more RI in the S condition than in the D condition.

One suggested explanation (e.g. Shuell, 1968) for the result is that the above FR experiments are analagous to the A-B, A-C, paradigm in paired associate learning. If the "A" term represents the category, and the "B" and "C" terms represents the specific words, RI would be predicted for S groups where "A" is constant over lists. In contrast, the D groups would be analagous to an A-B, C-D paradigm, with different categories ("A" and "C") in the two lists, and less RI would be predicted.

The purpose of the present experiment is to provide a further test of the paired-associate analogy in FR. In paired-associate learning it has been demonstrated that there is a direct relationship between stimulus similarity in successively learned lists and observed RI (Keppel, 1968). The suggested analog to stimulus similarity in the FR situation is organizational similarity. Therefore, if the paired associate analogy holds, RI in FR should covary with the extent to which two successively learned lists are organized in a similar fashion.

One index of the degree of organization in FR is clustering measures (e.g. Bousfield and Bousfield, 1966). Given the situation where two groups of Ss were presented with words from the same categories in successive FR lists, but the two

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groups showed quite different organizational consistencies (e.g., clustering scores), the prediction drawn from the paired associate analogy would be that the group having the highest organizational consistency would also have the greatest amount of RI.

One way to manipulate the degree of organization obtained with categorizable lists is to present the words blocked by category, (B) or to present them randomly (R). Several experiments (Cofer, Bruce, and Reicher, 1966; Puff, 1970) have demonstrated that presenting categorizable lists in B sequences results in higher clustering scores than presenting the same words in R sequences.

The present study investigated the effect of presenting both OL and IL lists in either B or R fashion. The lists consisted of 20 words five from each of four categories. The B condition involved presentation of all words from the same category consecutively, while the R condition involved presentation of the words in a random order, regardless of category. The prediction based on the paired associate analogy to RI in FR would be more RI for the B group than the R group.

In addition, to parallel previous studies, a factor of OL-IL similarity was included. Same (S) groups received OL and IL lists containing different words from the same categories, while different (D) groups received OL and IL lists containing words from different categories. There was also a control (C) condition which worked on a neutral activity (arithmetic problems) during the IL phase of the experiment. It was hypothesized that RI would be greatest for the S groups and least for the C groups. This hypothesis is consistent with the previous literature on the effect of organization on RI in FR.

Method

Design and Subjects. The experiment utilized a 2 (B or R presentation) x 3 (S, D, or C) factorial design.

There were a total of 120 Ss with 20 Ss randomly assigned to each of the six cells of the design. A restriction was that an equal number of males and females be assigned to each condition. All Ss were students at the University of Massachusetts, who volunteered to participate in the experiment for extra credit in psychology courses.

Materials

All lists consisted of twenty words: five from each of four categories drawn from the less frequent associate half of the Battig and Montague (1969) category norms. Memory drum tapes were prepared with appropriate lists (S or D and B or R) for each group. Three randomized orders of presentation were included on the tapes for each list. The B tape involved randomization of order of category presentation as well as randomization of words within each category. Group R tapes included presentations which were completely randomized regardless of category. The lists were counterbalanced for original or interpolated learning.

Procedure

The experimental session consisted of three phases: 1) acquisition of OL list; 2) acquisition of IL list; and 3) criterion recall of OL list. The acquisition phases (OL and IL) of the experiment consisted of alternating study and recall trials for all groups. During the study trials the words were presented on a memory drum at the rate of two seconds per word. Following each study trial there was a 90 seconds recall trial during which the S was requested to orally recall all of the words he could remember from the list he just studied. He was told that he could recall words in any order he chose.

The original learning (OL) phase of the experiment continued until the S correctly recalled 18 or the 20 words. Following attainment of criterion recall, the IL phase of the experiment began. The S and D groups studied and recalled the IL list in the same manner that they studied the OL list. There were a total of four IL study and recall trials regardless of the number of words recalled on any

trial. The C group was given ten minutes to work on arithmetic problems (the same amount of time spent on IL by the other groups). Following IL, all Ss were given three minutes to recall all of the OL words they could remember.

Results

Analyses of variance were computed for the following dependent variables: trials to reach criterion in OL; words recalled in IL; OL words recalled in a criterion recall trial following IL; and clustering indices. Sex of S was analyzed as a separate factor in hopes of reducing error variance. Since sex differences were not of interest in the present study, the sex main effect and interaction terms were pooled, and a single test was made, thus keeping type I error rate at a reasonable level (Anderson, 1968).

OL Learning

The main effect in OL acquisition due to type of presentation (B versus R) was significant [$F(1,108)= 11.4$, $p<.01$] . The nature of this effect was such that the R groups took more trials (mean = 4.0) to reach criterion than the B groups (mean = 3.2). No main effect was found for the OL-IL similarity factor ($F = 1.1$). The means for the S, D, and C groups were, respectively 3.8, 3.5, and 3.5.

IL Learning

The C groups worked on arithmetic problems during IL, and were therefore not included in the analysis of IL learning. The presentation factor was again significant in IL [$F(1,72)= 7.9$, $p<.01$] . As in OL, the B presentation led to more recall than the R presentation. Summing over trials the means for the B and R groups respectively were 65.5 and 61.6. There was also a main effect for IL learning due to OL-IL similarity [$F(1,72)= 23.8$, $p<.01$] . The nature of this effect was that the D groups recalled more words than the S groups (means equal 66.9 and 60.2 respectively).

Criterion Recall of OL Words

Following IL all Ss were asked to recall as many words as they could from the first list they studied. The presentation factor was not a significant source of variance for criterion recall of OL words ($F = 1.3$). However, the main effect due to OL-IL similarity was significant [$F(2,108)= 67.7$, $p < .01$] . The C groups recalled the most OL words (mean = 17.8) followed by the D groups (mean = 15.3), and the S groups recalled the fewest OL words (mean = 9.5).

Clustering Indices

Sequential category repetition (SCR) scores (Bousfield and Bousfield, 1966) were computed for the first and final trials of OL and IL, and for the criterion recall of OL words.

The important outcome for the present experiment was that the BS group evidenced significantly greater clustering scores than did the RS group [$F(1,72)= 9.0$, $p < .01$] . Collapsing over trials the mean observed to possible clustering ratios, (corrected for chance repetitions), were .82 and .46 for the BS and RS groups respectively. Since these groups received words from the same categories in OL and IL the higher clustering indices of the BS group indicates more similar organization between OL and IL for that group, than for the RS group. The remaining analyses of clustering (i.e. changes over trials) were consistent with previous studies.

Correlational Analyses

The fact that the B groups required fewer trials to reach criterion in OL than did the R groups leads to some ambiguity in interpreting the criterion recall results.Several paired associate studies (e.g. Underwood, 1964; Nelson, 1970) have demonstrated that the likelihood of recall for a given item is related to the number of times that item is correctly recalled during the acquisition phase of an experiment. Therefore, the additional practice on some items by the group

R Ss could have increased the likelihood of retention for those items. To test this possibility, correlation coefficients of trials to reach criterion in OL and words recalled in the criterion trial following IL were computed for the BS and RS groups. The correlations were in opposite directions (r= -.29 for BS group, r= .37 for RS group) and were found to be significantly different using an r to z transform [$Z = 2.01$, $p < .05$].

Discussion

The finding that groups receiving lists with the same categories exhibited more RI than groups with different categories supports the paired associate analogy of RI in FR and replicates previous findings (e.g. Shuell, 1968).

The present study provided an additional test of the paired associate analogy by manipulating organization of the lists. The argument being that organizational consistency is the FR analog to stimulus similarity in paired associate learning. If the paired associate analogy holds, then RI should be greatest in groups having the highest degree of organizational consistency on successively learned lists drawn from the same categories. As noted in the results section, Ss receiving B presentation sequences did organize the words to a greater extent than Ss receiving R sequences. However, the manipulation did not result in a significantly greater amount of RI for B presentation Ss when compared to Ss receiving R presentation. The critical comparison groups (BS vs RS) recalled 8.9 and 10.0 words respectively. The results are in the predicted direction, but failed to reach the level required for significance [$F(1,108) = 1.1$].

The correlations computed to determine the relationship between number of trials to reach criterion in OL and OL words recalled following IL indicated a basic difference between BS and RS groups. While increased trials in acquisition was positively related with increased recall for the RS group, the opposite relationship was found for the BS group. This indicates that a difference in trials

to acquisition explanation of RI for the BS and RS groups is not adequate. Rather, the difference in direction of the correlations suggests different processes in learning B and R lists and warrants further research.

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Footnotes

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